Exercise and Dementia: What should we be recommending?

Abstract

Purpose

Exercise has the potential to provide numerous benefits for people living with dementia, yet the balance of evidence is uncertain. This review is a synthesis of current evidence to determine (a) whether exercise improves health and wellbeing, and (b) what exercise should be recommended?

Design/Methodology/Approach

Structured search for existing literature reviews on exercise for dementia. Relevant articles were selected and critically appraised using a systematic approach. The findings from 15 high quality reviews were synthesised.

Findings

The evidence is convincing for improving physical health, promising for cognitive benefits, mixed for psychological benefits, and limited for behavioural outcomes. No evidence of harm was found. Overall, exercise can improve physical and mental health for people living with dementia, and there is sufficient evidence to recommend multimodal exercise.

Social implications

The potential beneficial outcomes are of significant importance both for people with dementia and their caregivers. It seems appropriate to follow the recommendation for older adults in general – some activity is better than none, more activity provides greater benefits. Adding social interaction may be important for psychological and behavioural outcomes

Originality

This review is the first to encapsulate the literature to date on exercise for dementia. Combining the findings from previous reviews enabled a novel synthesis across the range of relevant interventions and outcomes.

Key words: dementia, exercise, cognition, activities of daily living, behavioural outcomes, psychological outcomes, aerobic exercise, social interaction

Article classification: Literature review

Background

Worldwide, around 50 million people are living with dementia (WHO, 2019) (and this is predicted to rise to over 65 million cases by 2030 (Prince, 2013). Dementia is a symptom, or syndrome, in which there is an impairment of cognitive function beyond what might be expected with normal aging. Dementia results from a number of brain diseases with somewhat differing neurophysiology. While the most common is Alzheimer's disease, some people have more than one disease, and the distinction between them is not always clear. Dementia progresses at varying rates, affecting individuals in different ways. In the absence of a cure, treatment and care focuses on improving the lives of people with dementia and their carers/family through early diagnosis, information/advice, supporting physical and mental health, and tackling behavioural and psychological problems (WHO, 2019).

In addition to the impact on cognitive function, dementia is often accompanied by impairment in daily activities, leading to a decline in physical function (Barnes *et al*., 2015; Blankevoort *et al*., 2010). It has been argued that this decline in basic activities of daily living (ADL), leading to a deterioration of the person's autonomy, is a greater burden for caregivers than the cognitive decline (Blankevoort *et al*., 2010). The role of exercise in improving physical outcomes in older people without dementia is widely recognised (WHO, 2015), yet its role in those with dementia has not received as much attention. This may reflect physical activity being relatively difficult for people with dementia due to various factors such as extra pyramidal 'Parkinsonian' symptoms, impaired balance, gait disturbances, and reduced

walking speed (Atkinson *et al*., 2007; Eggermont and Scherder, 2006; Soumare, 2009). For the purpose of this review, physical activity is defined as 'any bodily movement produced by skeletal muscles that result in energy expenditure' (Casperson, Powell and Christenson 1985, p.126) and exercise as a 'purposeful, structured and repetitive movement intended for fitness' (Casperson, Powell and Christenson, 1985, p.128).

In addition to the cognitive impairment and decline in ADL in people with dementia, the accompanying behavioural issues can increase the difficulties for carers. Disruptive behaviour such as agitation, irritability, and affective behaviour (low mood, depression), along with sleep disturbances leading to wandering and nightly restlessness, can have a devastating impact on caregivers (Eggermont and Scherder, 2006). Behavioural problems can lead to a breakdown in family care and increased institutionalisation of dementia patients (Luppa *et al*., 2008).

There have been numerous attempts to use exercise as an intervention to improve the physical, cognitive, and behavioural problems experienced by people with dementia. Previous studies and literature reviews have looked at the potential effect on specific outcomes of exercise, but participants in a trial will often include numerous different diseases and neuropathological mechanisms, which may respond differently to different exercises, thus making it difficult reliably to identify specific effects.

In a climate of uncertainty where symptoms may be due to multiple underlying diseases with differing neuropathology, uncertainty over response to interventions, and absence of effective treatments, it is reasonable to explore the pragmatic question whether an intervention such as exercise reasonably can be recommended generally for people living with dementia and, if so, what the benefits might be. Thus, an overarching review of existing literature seems timely, and will help to answer the following questions for those living with dementia: 1) can exercise improve physical outcomes (functional ability, fitness, walking, ADLs, falls)? 2) can exercise improve cognitive outcomes (cognitive function, cognitive

ability)? 3) can exercise improve behavioural outcomes (agitation, sleep disturbance, wandering)? 4) can exercise improve psychological outcomes (depression, mood, quality of life? 5) for those living with dementia is the existing evidence sufficient to recommend exercise in general? 6) is there sufficient evidence to favour one or more types of exercise?

When recommending any exercise intervention, it is pertinent to be able to define its frequency, intensity, type, and time (FITT principle). The dose (FITT) of exercise may be an important contributor to outcomes, however, it also needs to be considered that there will be heterogeneous outcomes to the same external load (some individuals are more sensitive to physical effort and will respond differently to the same stimulus) (Herold 2019). Hence the dose needs to be specific to the internal load (individual psychophysiological response) rather than externa load (e.g. miles per hour). Therefore, in this review the details of the exercise intervention, dose of exercise and internal load are recorded, where available, in order to understand the type, volume and perceived intensity of exercise required to achieve an impact.

Methods

Approach

Based on our understanding of the disparate nature of the evidence in this field, a best evidence synthesis was considered to be the approach of choice. Designed to work with complex social interventions or programmes, it allows evaluation of the available literature and enables conclusions about the balance of evidence based on its quality, quantity and consistency − it sets the results in context so that practitioners and decision makers can reach an understanding that is likely to be of use to them when planning and implementing effective programmes (Goldsmith et al 2007; Pawson et al 2005; Slavin 1995). Where complex situations arise, it is important to include a wide range of knowledge and to use interpretation and judgement to arrive at any meaningful solutions (Greenhalgh, Thorne and Malteurd, 2018). In order to have confidence in our findings we use a systematic and

transparent method of data synthesis but do not restrict the included evidence base to reviews of RCTs. Whilst systematic reviews are useful in answering narrow rigid questions, exploration of complex, multifaceted problems having a rich diversity of evidence requires an interpretative, critical reflection of the wider evidence base (Greenhalgh, Thorne and Malteurd, 2018).

A search of the databases CINAHL (Cumulative Index of Nursing and Allied Health Literature), MEDLINE (Medical Literature Analysis and Retrieval System Online), PsycINFO and PubMed was conducted from January 2000 until August 2019 to identify published literature reviews of evidence on the impact of exercise in people with dementia. A keyword search included the terms treatment OR intervention OR symptoms AND dementia AND review AND physical activity OR exercise OR sport OR Fitness. In addition, reference lists (of the retrieved reviews) were hand searched and cross-referenced for further studies that may have been missed.

Selection criteria

Reviews were included if they met the following criteria: 1) A review of primary research (including systematic, narrative, critical reviews etc). 2) Participants were people with dementia (including Alzheimer's Disease (AD)) and their caregivers 3) Interventions included exercise (as defined above) 4) Outcomes measured either physical function (including physical function, fitness, walking, ADLs and falls), cognitive function, behavioural regulation (agitation, sleep disturbance, wandering) or psychological affect (depression, mood, quality of life) (or any combination of the above), and 5) Reviews published in English between January 2000 and August 2019.

Studies that investigated the role of exercise in preventing dementia in healthy adults were excluded. Physiotherapy, occupational therapy, and physical rehabilitation interventions were also excluded under our chosen definition.

Selection of studies and appraisal of evidence

Initially study titles were used to identify relevant review articles. Following this step, abstracts were reviewed to decide which articles met the inclusion criteria. Study quality was assessed following recommendations from York University's 'Centre for Reviews and Dissemination' (CRD) (CRD, 2009). Using the CRD criteria, reviews were designated as low, medium or high quality. High quality reviews met all the criteria, medium quality reviews met all except one or two criteria; and low quality reviews were missing three or more criteria (see Table 1). Three reviewers were involved in the decisions on which reviews to include/exclude. A total of 28 reviews met the inclusion criteria, of these 15 were designated as high quality. Given the number of high quality reviews available, all low and medium designation reviews were excluded, leaving the 15 high quality reviews for synthesis: since those are the more robust, they enable enhanced confidence in their reported findings). Although this is not a systematic review, a PRISMA flow chart mapping out the number of articles identified, excluded, and included should be helpful, and is given at Figure 1.

Search terms and databases

A search of the databases CINAHL (Cumulative Index of Nursing and Allied Health Literature), MEDLINE (Medical Literature Analysis and Retrieval System Online), PsycINFO and PubMed was conducted from January 2000 until August 2019 to identify published literature reviews of evidence on the impact of exercise in people with dementia. A keyword search included the terms treatment OR intervention OR symptoms AND dementia AND review AND physical activity OR exercise OR sport OR Fitness. In addition, reference lists (of the retrieved reviews) were hand searched and cross-referenced for further studies that may have been missed. The protocol for Preferred Reporting Items for Systematic Reviews and Meta-Analyzes (PRIMSA) was followed and this process is outlined in figure 1 (http://www.prisma-statement.org) (PRIMSA, 2015).

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Data extraction and synthesis

Information from the 15 selected reviews was collated in an evidence table designed to capture the essential data from the reviews (see Table 2). Initially, all relevant primary and secondary outcomes (as detailed in the reviews) were recorded, as well as whether or not the original authors concluded there was evidence of an intervention effect on these outcomes: a summary of the original authors' main conclusions are included in Table 2, and are expanded upon later in the Discussion section. The number of studies recorded in each review was noted and, where available, the total number of participants involved in the primary studies was also recorded. The data extraction, which included assessment of interventions, outcomes, impact, and FITT, was undertaken by the lead author and reviewed by all remaining authors to ensure fidelity. Once the extracted data were agreed, the findings were articulated as broad evidence statements related to the study aims. These were further discussed and refined against the sources of evidence, taking account of the robustness of the data. Finally, the findings were collated in an iterative manner by all members of the team and synthesised into evidence-linked answers to the research questions.

Findings

A wide range of reviews was found relating to exercise for people with dementia that met the inclusion criteria for high quality. Ten of the included reviews were limited to randomised control trials (RCTs) whilst the remaining five reviews included a wider range of study designs, including uncontrolled trials, pre-test post-test, case-control, cohort and qualitative research. In total there were 156 primary studies reviewed, and 57 of these were included in more than one review. The reviews included studies with a variety of exercise interventions (according to the FITT Principle), but a 'multimodal' intervention was the most common (two or more types of exercise such as aerobic, strength, balance training). The length of the intervention varied between 2 and 72 weeks. See Table 2 for the results from all of the included reviews.

1) Can exercise improve physical outcomes (functional ability, fitness, walking, falls, ADLs, falls) for people living with dementia?

A substantial body of evidence was found in support of the role of exercise in improving ADLs (Brett *et al*., 2016; Groot *et al*., 2016; Hernandez *et al*., 2015; Lam *et al*., 2018; Leng *et al*., 2018; Littbrand *et al*., 2011; Pitkala *et al*., 2013). Littbrand *et al*., 2011) conclude that although the type, intensity and frequency is still not clear, exercise which improves muscle strength and balance, allowing people to keep walking, appear to be important. Forbes et al. (2015) suggest the results for ADL's should be interpreted with caution, due to the low quality of the trials. However, a more recent review by Lam *et al*. (2018) reported significant benefits: importantly the three highest quality trials were consistent on these findings, two of which were not included in the Forbes review.

A number of reviews also found improvements in other physical outcomes: Bowes *et al*. (2013) - grip strength, walking speed, time-to-stand; Brett *et al*. (2016) - mobility, balance, Hernandez *et al*. (2015) - cardiovascular fitness, strength, flexibility, balance. Littbrand *et al*. (2011) found improvements in walking performance but limited evidence for balance and get-up-and-go performance. Lam *et al.* (2018) found strong evidence for sit-to-stand, step length, balance, get-up-and-go, and walking, but only weak evidence for flexibility. Potter *et al.* (2011) found some evidence for improvements in walking and timed get-up-and-go tests in older participants. Park and Cohen (2019) also found evidence for improvements in gait speed, walking endurance, balance and muscle strength in older participants. Pitkala *et al.* (2013) found only two high quality studies of older participants in institutional care, both of which found that physical function declined more slowly in the exercise intervention group (one study combined walking with conversation). They also looked at older people with dementia living at home, and again found two high quality trials that showed improvements in physical function in the exercise groups. Pitkala *et al.* (2013) also highlight, however, the low levels of compliance in older people with dementia, with studies tending to only report

results for those who complete the study, which may lead to overestimating the efficacy of the interventions.

Only one review explored the effectiveness of exercise for falls prevention (Lam *et al*., 2018): 3 high quality trials were included and found the results to be inconclusive.

2) Can exercise improve cognitive outcomes (cognitive function, cognitive ability) for people living with dementia?

There seems to be growing evidence for a slowing in the decline of cognitive function with exercise interventions in people with dementia (Bowes *et al.,* 2013; Brett *et al*., 2016; Cammisuli *et al*., 2018; Du *et al.,* 2018; Groot *et al.,* 2016; Hernandez *et al.,* 2015), but that conclusion is not universal. Forbes *et al.* (2015) claim there is no clear evidence of benefits on cognitive functioning from exercise, and describe the evidence as of very low quality, while Littbrand *et al.* (2011) state that the role of exercise on cognition is unclear either due to the quality of the studies, or because the intensity was too low. Cammisuli *et al.* (2018) in a narrative review on AD patients found that exercise may improve global functioning (in particular in the mild-moderate phase) but they could not conclude it definitely promotes a positive effect upon cognition, due to limitations of the tests of cognition used in the studies: nevertheless, they still recommend prescribing exercise to sedentary patients at the early stages to prevent cognitive deterioration. Similarly, Du ***et al's***. (2018) review of AD patients suggests exercise may prevent cognitive deterioration, but RCT's with 'clear intervention criteria, large samples and long term follow up are needed'. Brett *et al.* (2016) also suggest that results should be interpreted with caution: even though four high quality studies were found, three were low quality so a risk of bias was introduced. Hernandez *et al.* (2015), who only looked at people with AD, cautiously concluded that exercise should be considered as effective in improving sustained attention, visual memory, and frontal cognitive function. Parks and Cohen (2019) only found evidence of an effect of exercise on cognition for those with mild dementia. Bowes *et al.* (2013) in their realist review accept, on balance, that

exercise has potential benefits for cognitive function. Stronger evidence for the potential role of exercise on cognition comes from Groot *et al.* (2016), who obtained additional cognitive data from the authors of the original primary studies: they concluded there is a positive overall effect of exercise interventions on cognitive function, which remained when they excluded studies with a risk of bias and/or heterogeneity, and used post-hoc meta-regression analysis to reveal no significant moderator effects for age or disease severity. Overall, the results on cognitive function are promising but further robust studies are required as are reviews of evidence that differentiate between levels of cognitive impairment.

3) Can exercise improve behavioural outcomes (agitation, sleep, wandering) for those living with dementia?

There are many different aspects under the generic term 'behavioural' outcomes, and a variety of measures of each of these outcomes. This makes it difficult to extract information on which (if any) behaviours, may benefit from exercise. Barreto *et al.* (2015) conclude there is promising evidence for a beneficial effect on aberrant motor behaviour (e.g. wandering) but somewhat less for apathy and agitation. Fleiner *et al*., (2016) conclude that exercise is beneficial for behavioural outcomes (e.g. restlessness, improved sleep) based on five trials in acute care settings, while Brett *et al*., (2016) found a reduction in agitation in people with dementia in Nursing Care homes. Park and Cohen (2019) report mixed findings but still concluded that gentle exercise for older people is effective (and safe) in ameliorating behavioural symptoms, while accepting that less is known for those with severe dementia. The evidence to date on behavioural outcomes is too heterogeneous to draw firm conclusions, but it is a promising area for future studies.

4) Can exercise improve psychological outcomes (depression, mood, quality of life)?

Fewer studies measured psychological benefits from exercise interventions compared to physical and cognitive benefits. There were mixed findings for depression from no evidence (Potter *et al*., 2011, some Hernandez *et al*., 2015) to convincing evidence (Barreto *et al*.,

2015; Brett *et al*., 2016, Leng *et al*., 2018), with positive findings for mood (Brett *et al*., 2016; Bowes *et al*., 2013). Brett *et al.* (2016) found improvements in mood and depression, and described the evidence as of low risk of bias since they were from high quality studies. Leng *et al.* (2018) found positive results for depressive symptoms in those with dementia but not with mild cognitive impairment, suggesting the limited physical abilities of those with dementia may respond more to exercise than those with mild cognitive impairment who may already be active. Brett *et al.,* (2016) and Forbes *et al.* (2015) found that activities involving the caregiver or physical therapist in supervising the exercise led to psychological as well as physical health outcomes. In contrast Bowes *et al.* (2013) found home exercises were not effective in reducing depressive symptoms, suggesting that social interaction is important. Barreto *et al.* (2015) and Bowes *et al.* (2013) discuss the views of experts providing services for people with dementia (gleaned through interviews and surveys): it was felt that exercise is positive for quality of life (enjoyment, self-confidence etc.) when the exercise is fun and includes social interaction. Whilst this is not supported in the 'scientific literature' (Lam, 2018), it indicates that a regimented programme of activity used in a typical trial may not be the best form of activity to produce emotional response.

5) For those living with dementia is there existing evidence sufficient to recommend exercise in general?

There is no evidence from these reviews that exercise is detrimental to people living with dementia. There is convincing evidence that exercise improves physical health (in particular in older adults), promising evidence for improvements in cognitive function (in particular in mild dementia), mixed evidence for psychological outcomes (but more evidence for older adults), and limited evidence to support the role in behavioural outcomes. The consensus is that exercise can be recommended for people with dementia to improve their overall physical and mental health. There may be more benefits for those who are older and likely to be less active, but the cognitive benefits suggest that the earlier exercise is started the better (and this may in turn reduce levels of inactivity later in life).

6) Is there sufficient evidence in favour of one or more types of exercise?

The available evidence makes it difficult to prescribe what type, intensity, and frequency of exercise should be recommended. The most common intervention is the use of 'multimodal' exercise (two or more types such as aerobic, strength, balance training). Whereas Brett *et al.* (2016) and Hernandez *et al.* (2015) suggest exercise interventions involving multiple tasks and are aerobic are most effective in producing cognitive change, any functional improvements will require strength training. Barreto *et al.* (2015) and Bowes *et al.* (2013) suggest that enjoyment of activity for the individual is important for psychological outcomes, in particular for quality of life and wellbeing. As with all exercise prescriptions the exercise has to be specific to the required outcome. However, if we are to combine the outcomes (so as to provide optimal benefit across physical, cognitive, psychological, and behavioural outcomes) then we have to look at the whole individual. Many trials have been limited to one type of intervention for one type of outcome, yet a holistic approach would look at the person with dementia and the outcomes they consider important, with Bowes *et al.* (2013) suggesting that social interaction may be more important than the exercise itself in improving the lives of people with dementia.

Some reviews have made exercise recommendations. Pitkala ***et al's*** (2013) review on mobility and physical functioning recommends exercise at least twice a week with progressive increase in intensity. Lam *et al*., (2018), who reviewed a number of outcomes, suggest regular multimodal exercise with a combination of resistance, aerobic, balance, flexibility, and functional training for around 60 mins a day, 2-3 days a week: however, it is not clear what evidence they used to come to this conclusion. Looking specifically at ADL, they conclude that a wide range of exercise is effective, with protocols lasting from 20-150 minutes per session, with at least two sessions per week: however, due to the low number of high quality trials they advocate caution over the appropriate intensity (Lam *et al*., 2018). Groot *et al.* (2016) argued that the WHO recommendations for all older people (150 minutes

a week of aerobic, plus twice per week strength training) is the most sensible recommendation to follow for people living with dementia.

Discussion

This evidence synthesis is the first to encapsulate the range of research on exercise for dementia. Previous reviews have only looked at specific outcomes. By combining the findings from the available previous reviews in the area, the present review enables a synthesis across the range of interventions and outcomes. Since 15 high quality reviews were found, there is reason to be confident in the synthesis presented here without the need to include low or moderate quality reviews. The findings suggest there is a range of outcomes for which exercise may provide a positive impact, with the more recent studies suggesting the evidence base is improving. Barreto *et al.* (2015), in discussing the difference in their findings from those of Forbes *et al.* (2015) (significant impact on depression vs no impact), note that the evidence for benefit comes in part from clinical experience rather than scientific study, but also going back to the original authors enabled them to include a larger data set. This is also the case for Groot *et al.* (2018) who were able to add to data from the original trials (also by gathering information from original authors) to increase the data analysed, thus increasing confidence in the findings: as the number of trials increases and those of a lower quality removed from the reviews, the positive findings remain. Bowes *et al.* (2013) conclude that although further scientific study is required, there is no need to wait for this before recommending exercise because there are already strong indications of benefits. The emerging findings for people with dementia suggest they are just as likely to benefit from increasing physical activity levels as are people without dementia.

Studies on healthy older adults show that muscle strength, power, and flexibility can be improved by physical training throughout the lifespan (Peterson *et al.,* 2010). It should be no surprise therefore that the musculoskeletal system of people with dementia can also benefit from increased physical activity.

As dementia leads to such a range of potential degenerative outcomes (Blankevoort *et al.,* 2010), it would seem reasonable that a variety of different activities are required to meet multiple outcomes. Activities that involve attention from care staff may lead to improved behaviour through the increased social interaction and attention afforded to the individuals involved (Lamotte *et al.,* 2017): indeed, social interaction may be just as important as the exercise intensity (Barreto *et al*., 2015; Bowes *et al*., 2013). The activity environment may also be important for psychosocial impacts, as has been shown in older adults without dementia: for instance, exercising outdoors may provide additional benefits and bright light may help sleep at night (Pollock, 2012). Indeed, there is some evidence that music alongside exercise, such as in dancing, may positively affect brain activity in older people (Burzynska et al., 2017; Müller et al., 2017; Teixeira-Machado et al., 2018; Rehfeld et al., 2017; Rehfeld et al., 2018). While interesting, these aspects are under-explored in people living with dementia and there is currently insufficient robust evidence.

An important aspect to incorporate is that there will be interindividual variability in responses to exercise and many factors, both modifiable (e.g. diet) and non-modifiable (e.g. genetic), that may impact on the effect of exercise (Müller et al., 2019). While the current evidence does not allow all these factors to be taken fully into account, the breadth of studies across a range of individuals with dementia shows that many are likely to benefit from being more active. Although a 'one size fits all' recommendation may not be optimal (Müller et al., 2019), given the accumulation of evidence available, it seems evidently reasonable to recommend that the latest physical activity guidelines for older people - "Some physical activity is better than none: even light activity brings some health benefits compared to being sedentary, while more daily physical activity provides greater health and social benefits" (Department of Health & Social Care, 2019) - are appropriate for those with dementia. This is will result in general physical health benefits and may foster, to varying degree, cognitive, psychological, and behavioural benefits – importantly, without detriment.

Strengths and Limitations

Most of the reviews that informed this evidence synthesis combined original studies of high and low quality making it difficult to determine where the evidence was strongest. However, the strength of evidence, based on the quality of the primary research, was indicated in some of the reviews (e.g. Lam *et al.,* 2018): when this was controlled for there was no impact on the results (e.g. Groot *et al*., 2016), and it was the higher quality studies that were more likely to support the role of exercise (Lam *et al*., 2018). Other limitations of the reviews included a lack of detail on the exercise intervention (in particular exercise intensity), lack of detail on the disease severity, and lack of data on the demographic details of participants. Again, though, when these differences were controlled for there was no impact on results (Groot *et al*., 2016).

The more recent reviews show that the evidence base is increasing and indicates a beneficial effect of exercise on people with dementia. Forbes *et al.* (2015) was a Cochrane Review of 17 trials, in which the heterogeneity of studies regarding type of exercise and severity of dementia was noted with a call for well-designed trials. Groot *et al.* (2016) and Barreto *et al.* (2015) took the useful step of contacting the original authors for additional data to be able to conduct moderator effects, thus providing more confidence in the findings. More recently, Lam *et al.* (2018) had more trials to draw on (43) and were able to analyse for severity of disease, again adding to confidence in their findings. Including just the high quality reviews and reporting only after careful synthesis, enhances our confidence in the range of findings presented here.

Future research

While the research in this area is increasing and improving, the picture is incomplete. The reviews to date all note that heterogeneity in study design, exercise intervention, population sampled, and outcome measures, make it difficult to consolidate the findings. Moreover, the stage of dementia, support available, and previous experience of the person with dementia may influence how they perceive and engage with exercise. These are all areas that usefully

can be considered in future studies. Furthermore, it needs to be recognised that exercise is a complex intervention (due to the various combinations of the FITT principle) and it is difficult to isolate and control the elements of the intervention. Indeed, it may be the complexity of exercise (social and psychological and physical impacts) that makes it effective. While more and better trials remain pertinent, there is also good reason to look towards different forms of evidence, e.g. data from current services (Bowes *et al*., 2013), and to focus on how to optimise the implementation of interventions in this challenging population.

Conclusion

There is a wealth of evidence endorsing that exercise is beneficial to healthy older adults (Chodzko-Zajko *et al*., 2009), and similar evidence for older adults with dementia has now emerged. Whilst further studies are warranted to determine the detail, there seems no good justification to wait for further evidence before exercise becomes part of routine care for people living with dementia. The potential beneficial outcomes, as revealed through combining the results of previous reviews into the present overview, are wide ranging and of significant importance both to people with dementia and their caregivers. Moreover, no evidence of harm has been found.

While there are significant challenges in implementing exercise interventions for people with dementia, we consider that there is now enough evidence to support the inclusion of exercise in the care plans of people living with dementia. Without strong evidence for any specific exercise prescription, a pragmatic recommendation is the advice given for older people in general, with the aim of improving or maintaining muscle strength, balance, and flexibility - an activity goal of 150 minutes a week of moderate intensity aerobic exercise, focusing on weight-bearing activities and avoidance of prolonged periods being sedentary. The main message being any activity is better than none at all and more activity provides

greater benefits (DHSC 2019) – precisely how this is achieved may be less important than whether it is achieved.

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